DETAILED ACTION

Specification

1. The amendment filed 04/16/2010 is objected to under 35 U.S.C. 132(a) because it introduces new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: the amendment of replacing "the conduction band edge" with "the valence band edge" in the paragraph at pages 23, line 24 to page 24, line 6.

Applicant is required to cancel the new matter in the reply to this Office Action.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. **Claims 18-19** are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

4. Claim 18 recites “the p-electrode has a work function higher than a valence band edge energy of the inorganic semiconductor material” in the last two lines of the claim which is different from what is disclosed in the original disclosure: “the work function of the p-electrode

is higher than the conduction band edge energy of the ambipolar inorganic semiconductor" as disclosed in the first two lines of page 24.

5. Claim 19 is rejected because they depend on the rejected claim 18.

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. **Claims 18-19** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

8. Claim 18 recites "a conduction band edge energy" in the 11th line of the claim, while a reference energy level is not defined. The value of the energy level of the conduction band edge is only determined when a reference energy level, i.e. 0 energy level is defined. Without defining the reference energy level, the value of the conduction band edge energy is ambiguous. Applicant is advised to specify the reference energy level or use a term that already has the reference level defined, e.g. electron affinity.

9. Claim 19 is rejected because they depend on the rejected claim 18.

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

11. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

12. **Claims 1-2, 4-9, 12-15, 17-19, and 22** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawazu et al. (US 5,539,239 A) in view of Shimizu et al. (US 2003/0063462 A1) as can be understood since claims 18-19 have been rejected under 35 U.S.C. 112.

13. Regarding **claim 1**, Kawazu et al. teach a light-emitting diode (semiconductor light emitting element; Abstract) characterized by comprising: an electron injecting electrode, that is, an n-electrode (n type ZnSe cladding layer 5; Fig. 1, col. 7 lines 13-14); a hole injecting electrode, that is, a p-electrode (p type ZnSe cladding layer 3; Fig. 1, col. 7 line 8); and an inorganic light-emitting film (undoped ZnSe active layer 4; Fig. 1, col. 7 lines 11-12) wherein the inorganic light-emitting film (4) (1) is formed of an inorganic semiconductor material (undoped ZnSe; col. 7 lines 11-12) having an ambipolar property in which the ratio of respective mobilities of electrons and holes is in a range of 1/10 to 10 (undoped ZnSe has this property), (2) is disposed between the n-electrode (5) and the p-electrode (3) so as to respectively contact the n-electrode and the p-electrode (5 and 3) in a non-barrier junction manner (5, 4, 3 form a p-i-n diode which is considered in a non-barrier junction manner as the diode conducts in the forward biased condition) such that the inorganic semiconductor material (undoped ZnSe) conducts both electrons injected from the n-electrode (5) and holes injected from the p-electrode (3; conducting

both electrons and holes is an intrinsic property of undoped ZnSe), wherein the inorganic light-emitting film (4) emits light resulting from electrons injected from the n-electrode (5) and holes injected from the p-electrode (3) recombining between the two electrodes (5 and 3; the light emitting is an intrinsic property of this PIN diode), and wherein the inorganic semiconductor material having the ambipolar property (undoped ZnSe) is selected from the group consisting of (a) a group II-VI compound and (b) Zn and at least one element selected from the group consisting of S, Se and Te (i.e. Zn and Se).

Kawazu et al. do not teach an inorganic semiconductor material deposited on a glass substrate, the inorganic light-emitting film has a thickness in a range of 100 nm or more and 10 μm or less, the inorganic semiconductor material deposited on the glass substrate.

Kawazu et al. teach the inorganic light-emitting film (3) has a thickness of 10 nm (col. 7 lines 11-12) which is close enough to the claimed range of 100 nm or more and 10 μm or less that one skilled in the art would have expected them to have the same properties, which establishes a prima facie case of obviousness (MPEP 2144.05 [R-5] I).

Furthermore parameters such as the thickness of the inorganic light-emitting film in the art of semiconductor manufacturing process are subject to routine experimentation and optimization to achieve the desired film quality during device fabrication. Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to incorporate the thickness of the inorganic light-emitting film within the range as claimed in order to form a high quality film.

In the same field of endeavor of LEDs, Shimizu et al. teaches an inorganic semiconductor material (the material of the LED chips 72 which can be ZnSe-based; paragraph [0069, 0143,

and 0144]) deposited on a glass substrate (heat-dissipating substrate 73 which can be a glass epoxy substrate; Figs. 16A and 16B, paragraph [0144]), the inorganic semiconductor material (the material of the LED chips 72 which can be ZnSe-based) deposited on the glass substrate (73).

It would have been obvious to one of ordinary skill in the art at the time of invention was made to combine the inventions of Kawazu et al. and Shimizu et al. and use the glass substrate as taught by Shimizu et al., because the glass substrate can dissipate the heat generated by the LED chip and increase the lifetime of the LED chip as taught by Shimizu et al. (paragraph [0144]).

14. Regarding **claim 2**, Kawazu et al. also teach the light-emitting diode according to claim 1, characterized in that the inorganic light-emitting film (4) consists of a semiconducting material (undoped ZnSe) having a dopant concentration of 0.1% or less in atomic ratio (zero as it is undoped).

15. Regarding **claim 4**, Kawazu et al. also teach the light-emitting diode according to claims 1 or 2, characterized in that the n-electrode (5) includes a layer (5) comprising an n-type dopant (Cl; col. 7 line 15) and the inorganic semiconductor material having the ambipolar property (ZnSe; col. 7 lines 13-14).

16. Regarding **claim 5**, Kawazu et al. also teach the light-emitting diode according to any claims 1 or 2, characterized in that the p-electrode (3) includes a layer (3) comprising a p-type dopant (N; col. 7 line 10) and the inorganic semiconductor material having the ambipolar property (ZnSe; col. 7 line 8).

17. Regarding **claim 6**, Kawazu et al. also teach the light-emitting diode according to claims 1 or 2, characterized in that the n-electrode (5) includes a first layer (5) comprising an n-type

dopant (Cl; col. 7 line 15) and the inorganic semiconductor material having the ambipolar property (ZnSe; col. 7 lines 13-14), and the p-electrode (3) includes a second layer (3) comprising a p-type dopant (N; col. 7 line 10) and the inorganic semiconductor material having the ambipolar property (ZnSe; col. 7 line 8).

18. Regarding **claim 7**, Kawazu et al. also teach the light-emitting diode according to claims 1 or 2, characterized in that a material (ZnSe) of a portion contacting the inorganic light-emitting film (4) in at least one of the n-electrode (5) and the p-electrode (3) is formed by use of a material (ZnSe) substantially different from the material of the inorganic light-emitting film (CdZnSe of the CdZnSe-ZnSe multi-quantum well layer 21; Fig. 6, col. 2 lines 42-43)

19. Regarding **claim 8**, Kawazu et al. also teach the light-emitting diode according to claims 1 or 2, characterized in that the n-electrode (5) and the p-electrode (3) are formed on opposing sides of the inorganic semiconductor material having the ambipolar property (4), wherein the n-electrode (5) and the p-electrode (3) do not contact each other (see Fig. 1).

20. Regarding **claim 9**, Kawazu et al. also teach the light-emitting diode according to claims 1 or 2, characterized in that a first one of the n-electrode (5) and the p-electrode (3) is deposited on a crystalline substrate or a glass substrate (GaAs substrate 1; Fig. 1, col. 7 line 4), and the inorganic semiconductor material having the ambipolar property (4) is stacked thereon (4 is stacked on 1), and a second one of the p-electrode (5) and the n-electrode (3) is stacked thereon (5 and 3 are stacked on 1).

21. Regarding **claim 12**, Kawazu et al. also teach the light emitting diode according to claim 1, wherein only one such inorganic light-emitting film (4) is formed between the p-electrode (3) and the n-electrode (5).

22. Regarding **claim 13**, Kawazu et al. also teach a light-emitting diode (semiconductor light emitting element; Abstract), comprising: an electron injecting n-electrode (n type ZnSe cladding layer 5; Fig. 1, col. 7 lines 13-14); a hole injecting p-electrode (p type ZnSe cladding layer 3; Fig. 1, col. 7 line 8); an ambipolar light-emitting film (undoped ZnSe active layer 4; Fig. 1, col. 7 lines 11-12) (1) continuously extending from the n-electrode (5) to the p- electrode (3; see Fig. 1), (2) consisting of an ambipolar semiconducting material (undoped ZnSe, an ambipolar material which can transport electrons and holes; col. 7 lines 11-12) which conducts both electrons injected by the n-electrode (5) and holes injected by the p-electrode (3; conducting both electrons and holes is an intrinsic property of undoped ZnSe), and (4) comprising a first semiconductor material (ZnSe) selected form the group consisting of (a) a group II-VI compound and (b) Zn and at least one element selected from the group consisting of S, Se and Te (i.e. ZnSe).

Kawazu et al. do not teach an ambipolar semiconductor material which is deposited on a glass substrate, an ambipolar light-emitting film having a thickness in a range of equal to or greater than 100 nm and no more than 10 μm.

Kawazu et al. teach an ambipolar light-emitting film (3) having a thickness of 10 nm (col. 7 lines 11-12) which is close enough to the claimed range of 100 nm or more and 10 μm or less that one skilled in the art would have expected them to have the same properties, which establishes a prima facie case of obviousness (MPEP 2144.05 [R-5] I).

Furthermore parameters such as the thickness of the ambipolar light-emitting film in the art of semiconductor manufacturing process are subject to routine experimentation and optimization to achieve the desired film quality during device fabrication. Therefore, it would

have been obvious to one of the ordinary skill in the art at the time the invention was made to incorporate the thickness of the ambipolar light-emitting film within the range as claimed in order to form a high quality film.

In the same field of endeavor of LEDs, Shimizu et al. teaches an ambipolar semiconductor material (the material of the LED chips 72 which can be ZnSe-based; paragraph [0069, 0143, and 0144]) which is deposited on a glass substrate (heat-dissipating substrate 73 which can be a glass epoxy substrate; Figs. 16A and 16B, paragraph [0144]).

It would have been obvious to one of ordinary skill in the art at the time of invention was made to combine the inventions of Kawazu et al. and Shimizu et al. and use the glass substrate as taught by Shimizu et al., because the glass substrate can dissipate the heat generated by the LED chip and increase the lifetime of the LED chip as taught by Shimizu et al. (paragraph [0144]).

23. Regarding **claim 14**, Kawazu et al. also teach the light-emitting diode of claim 13, wherein the ambipolar light-emitting film (4) consists of the first semiconductor material (ZnSe; col. 7 lines 11-12).

24. Regarding **claim 15**, Kawazu et al. also teach the light-emitting diode of claim 13, wherein the first semiconductor material (ZnSe) is Zn and at least one element selected from the group consisting of S, Se and Te (i.e. Se).

25. Regarding **claim 17**, Kawazu et al. also teach the light-emitting diode according to claim 1, wherein the inorganic light-emitting film (4) consists essentially of the inorganic semiconductor material having the ambipolar property (ZnSe; col. 7 lines 11-12).

26. Regarding **claim 18**, Kawazu et al. teach a light-emitting diode (semiconductor light emitting element; Abstract) characterized by comprising: an electron injecting electrode, that is,

an n-electrode (n type ZnSe cladding layer 5; Fig. 1, col. 7 lines 13-14); a hole injecting electrode, that is, a p-electrode (p type ZnSe cladding layer 3; Fig. 1, col. 7 line 8); and an inorganic light-emitting film (undoped ZnSe active layer 4; Fig. 1, col. 7 lines 11-12), wherein the inorganic light-emitting film (4) is disposed between the n-electrode (5) and the p-electrode (3) so as to respectively contact the n-electrode (5) and the p-electrode (3; see Fig. 1) and is formed of an inorganic semiconductor material having an ambipolar property (ZnSe) in which the ratio of respective mobilities of electrons and holes is in a range of 1/10 to 10 (ZnSe has this property), wherein the inorganic light-emitting film (4) emits light resulting from electrons injected from the n-electrode (5) and holes injected from the p-electrode (3) recombining between the two electrodes(5 and 3; the light emitting is an intrinsic property of this PIN diode), wherein the inorganic semiconductor material having the ambipolar property (ZnSe) is selected from the group consisting of (a) a group II-VI compound and (b) Zn and at least one element selected from the group consisting of S, Se and Te (i.e. Zn and Se), wherein the n-electrode (n type ZnSe) has a work function lower than a conduction band edge energy of the inorganic semiconductor material having the ambipolar property (undoped ZnSe), and wherein the p-electrode (p type ZnSe) has a work function higher than a valence band edge energy of the inorganic semiconductor material having the ambipolar property (undoped ZnSe; this relationship of work functions, the conduction band edge energy, and the valence band edge energy is intrinsically satisfied as the three layer structure of p-ZnSe/undoped_ZnSe/n-ZnSe with undoped ZnSe as the active layer is exactly the same as the examples shown in the second paragraph of page 25 of the instant application).

Kawazu et al. do not teach an inorganic light-emitting film has a thickness in a range of 100 nm or more and 10 μm or less.

Kawazu et al. teach an inorganic light-emitting film (3) has a thickness of 10 nm (col. 7 lines 11-12) which is close enough to the claimed range of 100 nm or more and 10 μm or less that one skilled in the art would have expected them to have the same properties, which establishes a prima facie case of obviousness (MPEP 2144.05 [R-5] I).

Furthermore parameters such as the thickness of the inorganic light-emitting film in the art of semiconductor manufacturing process are subject to routine experimentation and optimization to achieve the desired film quality during device fabrication. Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to incorporate the thickness of the inorganic light-emitting film within the range as claimed in order to form a high quality film.

27. Regarding **claim 19**, Kawazu et al. also teach the light-emitting diode of claim 18, wherein the inorganic light-emitting film (4) contacts the n-electrode (5) without forming a barrier therebetween (the intrinsic property of n type ZnSe and undoped ZnSe) and the inorganic light-emitting film (4) contacts the p-electrode (3) without forming a barrier therebetween (the intrinsic property of p type ZnSe and undoped ZnSe).

28. Regarding **claim 22**, Kawazu et al. also teach the light-emitting diode of claim 1, wherein the inorganic light-emitting film (4) contacts the n-electrode (5) without forming a barrier therebetween (the intrinsic property of n type ZnSe and undoped ZnSe) and the inorganic light-emitting film (4) contacts the p-electrode (3) without forming a barrier therebetween (the intrinsic property of p type ZnSe and undoped ZnSe).

Response to Arguments

29. Applicant's amendments, filed 06/20/2011 and 08/15/2011, overcome the rejections to claim 24 under 35 U.S.C. 112. The rejections to claim 24 under 35 U.S.C. 112 have been withdrawn.

30. Regarding to the new matter objection to specification, the applicant argues that the amendment is to correct an obvious error in the specification using support of the declaration from Dr. Mashiro ORITA and Prof. Hiromichi OHTA who quote the textbook of "Semiconductor Physical Electronics" by Sheng S. Li.

31. The examiner respectfully disagrees because matter not in the original specification, claims, or drawings is new matter (MPEP 608.04(a)). Applicant has to show the support of the amended matter from the original disclosure to overcome the objection. The declaration from Dr. Mashiro ORITA and Prof. Hiromichi OHTA, and the textbook of "Semiconductor Physical Electronics" by Sheng S. Li are not the original disclosure and could not overcome the new matter objection.

32. Regarding to the written description rejection of claims 18 and 19, Applicant argues that the claims would be adequately support in the description of the invention if the new matter rejection of the specification is removed. As the new matter rejection of the specification still stands, the written description rejection of claims 18 and 19 also stands.

33. Regarding to the rejection of claims 18 and 19 under 35 U.S.C. 112 second paragraph, Applicant argues that the ordinary mechanic recognizes that all parts of a complex band structure should be referenced to a common level and the vacuum level is a satisfactory reference level,

and, Secondly, a lack of a reference level does not render a value of one parameter meaningless if that value is being compared, as in the claims, to the value of another parameter.

34. The examiner respectfully disagrees because, firstly, the vacuum level usually is not used as a reference energy level. Secondly, only two values with the same physical attribute can be compared. Claim 18 is comparing “work function” with “conduction band edge energy”. “Work function” is defined as **the difference of two energy levels**, while “conduction band edge energy” is only one energy level, and thus they cannot be compared.

35. Applicant's arguments with respect to claims 1, 13 and 18 have been considered but are moot in view of the new ground(s) of rejection. Only arguments addressed to previous limitations are addressed here.

36. On pages 9-11 of Applicant’s Response, Applicant argues that Kawazu teaches a 10 nm quantum-well layer, and the ordinary mechanic understands that an active layer of thickness of 100 nm or more does not form a quantum well and operates significantly differently from Kawazu's 10 nm quantum-well layer. Further, the factor of ten for the difference in thickness is beyond the range of routine experimentation.

37. The Examiner respectfully disagrees with Applicant’s argument, because Kawazu does not teach a 10 nm quantum-well layer. Kawazu teaches an undoped ZnSe active layer having a thickness of 10 nm (col. 7 lines 10-12) and there is no reason why Kawazu’s ZnSe active layer cannot be thicker than 10 nm, e.g. 100 nm. A factor of ten for the difference in thickness is not beyond the range of routine experimentation.

38. On page 12 of Applicant’s Response, Applicant argues that Shimizu uses a glass epoxy substrate as the mounting substrate, not the claimed glass substrate.

39. The Examiner respectfully disagrees with Applicant's argument, because a glass epoxy substrate is a glass substrate as claimed.

40. On page 11 of Applicant's Response, Applicant argues that the Kawazu's active layer is not exactly the same as the examples in the instant application.

41. The Examiner respectfully disagrees with Applicant's argument, because Kawazu teaches the three layer structure of p-ZnSe/undoped_ZnSe/n-ZnSe with undoped ZnSe as the active layer which is exactly the same as the examples shown in the second paragraph of page 25 of the instant application. The difference in thickness is just an obvious variant.

Conclusion

42. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to HSIN-YI HSIEH whose telephone number is (571)270-3043. The examiner can normally be reached on Monday to Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lynne A. Gurley can be reached on 571-272-1670. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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10/21/2011